Environmental Leadership Program

FINAL REPORT

PUGET SOUND NAVAL SHIPYARD
OCTOBER 1996

EXECUTIVE SUMMARY

The Environmental Leadership Program (ELP) represents a new alliance between government and industry to advance the major principles embodied in environmental excellence. Puget Sound Naval Shipyard, a recognized leader for its environmental commitment, expanded the ELP precept and embarked with the regulatory community on a unique year long ELP Pilot Project to develop a *process* for exploring, testing and validating innovative pollution prevention measures. These measures can truly benefit our environment yet may be prohibited by unintended regulations. The Pilot Project focused on the Toxic Substances Control Act (TSCA) and the regulations relating to Polychlorinated Biphenyls (PCBs). These regulations currently force tons of recycled premium naval construction steel into TSCA landfills because the paints, insulating foams and plastic materials used in naval construction over the past 30 years were formulated with PCBs and are often impossible to fully remove from the steel. Exploring, testing and validating the hypothesis that the PCBs used to formulate these materials are inextricably bound within a polymer matrix and, consequently, should not be regulated under TSCA is the proposal advanced during this year long Pilot Project. In an effort to support alternative disposal methods, the proposal also examined the by-products of PCB containing materials which are incinerated. Analysis of these materials which have been inadvertently burned showed no evidence of dioxins or dibenzofurans. This Final Report concludes the Pilot Project, however, as the year long effort ended without completely validating the proposal, the research will continue and the future results will be published for industry use. The ELP was intended to be a step away from the regulatory command and control philosophy of the past towards a more creative forum that could affect measurable improvement to the environment. In order to achieve this, industry must be allowed to "step out of the box." The challenge for all participants is to achieve complete consensus in the objectives and approaches towards future initiatives such as the ELP. Puget Sound Naval Shipyard has benefited from its participation in the ELP. These benefits are marked by improved working relations with the regulatory community, public recognition for its environmental commitment and by the development of a *process* which represents an Environmental Management System designed to advance the principles of environmental excellence.

A. Environmental Leadership Program

Working towards the common goal of advancing environmental excellence for the next century, EPA Administrator, Carol Browner, forged a new partnership with recognized leaders in industry to develop and share innovative approaches to environmental principles. The Environmental Leadership Program (ELP), initiated in April of 1995 as part of the Clinton Administration's "Reinventing of Environmental Regulation," represented a new alliance between government and industry in advancement of the major principles embodied in environmental excellence. Twelve competitively selected industrial environmental leaders, in partnership with regulatory agencies, embarked on year long pilot projects designed to advance the principles of:

- Environmental Management Systems
- Multimedia Compliance Assurance Processes
- Independent Verification of Compliance Audit Methods
- Self-Certification
- Public Accountability
- Community Involvement
- Mentoring

This Final Report profiles the environmental leadership policy embraced by Puget Sound Naval Shipyard then focuses on the goals, successes and problems realized during its year long Environmental Management Systems pilot project.

B. Puget Sound Naval Shipyard's Proposal

Puget Sound Naval Shipyard, chosen from among approximately 41 other candidates to participate in the program, expanded the precepts to propose a unique pilot project which models the *process* for partnering with environmental regulatory agencies to explore, test and validate innovative pollution prevention measures which truly benefit our environment yet are prohibited by unintended regulations. The Shipyard's proposal focuses on the Toxic Substances Control Act (TSCA) and the regulations relating to Polychlorinated Biphenyls (PCBs).

One of the primary industrial activities at the Shipyard is recycling of the premium grade steel used in Naval Submarines. Current PCB regulations require that paint, insulation, syntactic foam and other solid materials be removed before the steel can be recycled. This is very costly in terms of manpower, management and waste as often steel pieces cannot be cleaned and become destined for TSCA landfills.

Preliminary assessments by the Navy leads the Shipyard to believe that although PCB's were used in the production of items such as paint, foam and plastics, the process converted the PCB to an unregulated final chemical product. In pursuing this hypothesis, the Shipyard's ELP proposal focused on the extraction, analysis and disposal procedures for solid materials that were formulated with PCBs as plasticizers. This proposal, unique from among the other 12, expanded the Environmental Management System precepts to invoke a *process* for exploring, testing and validating innovative pollution prevention measures. If successful, the Shipyard would be able to recycle 2500 tons of steel annually, which is currently disposed of in TSCA landfills, and eliminate up to 7 tons of methylene chloride, a solvent used in the chemical extraction and analysis of PCBs, from its annual air emissions.

II PUGET SOUND NAVAL SHIPYARD

A. Puget Sound Naval Shipyard's Environmental Commitment

Embracing environmental excellence is a guiding principle in corporate leadership at Puget Sound Naval Shipyard. Being the only nuclear submarine and ship recycling facility in the world and home to over 18,000 civilian and military employees, Puget Sound Naval Shipyard has a responsibility and commitment towards preserving the vitality of the region. It is a recognized leader in industry, having received the prestigious:

- Commander-in-Chiefs Installation Excellence Award, 1995, 1991
- Secretary of the Navy's Recycling Award, 1995
- Secretary of the Navy's Environmental Quality Award, 1994
- Department of Energy's Federal Energy and Water Management Award, 1993, 1994
- Secretary of the Navy Energy Conservation Award, 1993, 1994

B. The Industrial Complex

Puget Sound Naval Shipyard is a 344 acre industrial and homeport complex. The Shipyard's six dry docks, nine piers and 328 buildings are located on the shores of Sinclair Inlet. The Shipyard is well equipped to support most of its own needs. Its Public Works Department operates a Steam Utilities Plant for power and heat and there is a state-of-the-art manufacturing machine shop facility housed within an 11 acre site.. The shipyard has many "mini-industries" on site which employ the following trades: forge, foundry, welding, shipfitter, boilermaker, pipefitter, sheetmetal, insulator, woodworker, painter, electroplater, electric and machinist. Employees work within their shops as well as onboard ships, in dry

docks and pierside. In addition, the Shipyard operates and maintains a large fleet of vehicles, a railroad system and numerous cranes.

The Shipyard is also a full service homeport for a Nuclear Aircraft Carrier and its complementary support Battle Group. To provide these homeport services, the Shipyard complex includes many houses, new state-of-the art bachelor dormitories, a large recreational facility and a complete retail center. Additionally, the Shipyard operates its own Police and Fire Departments who not only respond within the complex but also render assistance within the surrounding community.

C. The Shipyard Processes

The Shipyard is workplace to approximately 9,000 civilian and 9,000 military employees. The two primary industrial processes performed are the repair/overhaul of Navy vessels and the inactivation/recycling of nuclear submarines and surface vessels.

The job of maintaining and overhauling these vessels involves all trades at the Shipyard, from the engineers who design work to the metal workers who actually make the nuts and bolts which are used shipboard.

The process of recycling involves the dismantling of ships, salvaging of the parts that are reusable, preparation of the other parts for recycling and then disposal of the pieces that cannot be reused or recycled. The goal is reuse, as much as possible, commensurate with the generation of a minimum amount of waste. The ELP Pilot Project focused on the methodologies employed in this process as performed under current environmental regulation.

D. Environmental Management Systems

Shipyard Environmental Management policy originates within the Department of Environmental Health and Safety. Under the Director, there are two Divisions, one for Health and Safety and the other for Environmental. Within the Environmental Division there are three Branches:

- The Water, Pollution Prevention, Pretreatment and Air Programs Branch
- The Hazardous Materials, Hazardous Waste, Remediation and Solid Waste Management Programs Branch
- The Emergency Spill Response and Prevention, Disaster Preparedness and PCB Programs Branch

There is a manager for every program and most programs are staffed with several engineers, scientists or technicians. Each program manager is responsible for generating the instructions

which detail how Shipyard work will be performed in order to comply with environmental regulation and Navy policy. In addition, the program staff generates all permits, plans and reports required by regulation.

Environmental Coordinators are the liaisons between Shipyard production workers and program staff. These Coordinators are proactively involved with the employees engaged in the principles and instructions of environmental work. Further, through continuous process improvement, the Coordinators become the vital link in developing new pollution prevention initiatives proposed by employees closest to the work.

Together, the Program managers, their staff, the Coordinators and production workers form an Environmental Management System structured to design, implement and continually improve the environmental policies embraced by the Shipyard.

III THE PILOT PROJECT

A. Goals and Objectives

The ELP Pilot Project focused on the principle goal of modeling the *process* for partnering with environmental regulatory agencies to explore, test and validate innovative pollution prevention measures which truly benefit our environment yet are prohibited by unintended regulation. In doing so, the Shipyard achieved three major objectives:

- Development of an Environmental Management System designed to explore, test and validate innovative pollution prevention measures.

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- Improved working relationships with the regulatory community.

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- A spotlight on the progress the Shipyard has made in advancing the principles of environmental excellence.

B. Project Description

Identifying an Unintended Regulation

Through its ship recycling program, the Shipyard currently spends 10 to 12 million dollars per year analyzing, removing and disposing of plastic insulated cabling, foam rubbers and painted ship structures that test above 50 ppm for PCBs. The PCB's were used as plasticizers and heat stabilization additives in the formulation of these materials and, as such, comprised approximately 5% by weight of the original formula. During polymerization, the PCBs are incorporated with other monomer units to form molecules. So, while PCB's were part of the original formulation, they do not exist in the final product. This is evident in the that these materials test negative for PCBs using a standard wipe test where, even after rigorous chemical extraction, recoveries average less than 1%. It is thought that the only reason any PCBs are recovered is that the extraction actually dissolves some of the chemical bonds in the polymer chains whereby some PCBs are released. The reason all the PCBs are not recovered is that dissolution of chemical bonds is random and every possible combination of monomers, from full size chains to single units, will exist in an extraction solution. This means that the PCBs that remain bonded, in some way, to other monomer units would be dismissed, correctly, as something else. By analogy, styrene is one of the monomers use to form Styrofoam. Before polymerization, the styrene monomer is a highly flammable, poisonous liquid that is classified as a carcinogen. After polymerization, the finished product is inert and is regularly recycled or disposed of in solid waste land fills.

The current PCB disposal policy exposes workers and the environment to tons of volatile organic solvents and uses up large amounts of very limited TSCA landfill resources. Changing that policy requires an innovative pollution prevention measure coupled with a cooperative effort among the regulatory community to implement it.

Developing An Innovative Pollution Prevention Measure

To demonstrate the theory that PCBs are inextricably bound in a polymer matrix and, concurrently, reduce the amount of volatile chemicals used by conventional extraction methods, the Shipyard explored the principle of Supercritical Fluid Extraction (SFE) for PCB analysis. The SFE method employs the features of a supercritical fluid, a substance which exhibits the characteristics of both a fluid and a gas when at a specific temperature and pressure, to selectively extract the PCBs bound within the polymer matrix of solid materials. In addition, the Shipyard pursued an evaluation of the by-products resulting from the incineration of PCB containing foam and rubber materials to support alternate disposal options for these materials. Testing of inadvertently burned materials of this kind show no detectable levels of dioxins or dibenzofurans.

C. The Process

The ELP was the opportunity for partnering with environmental regulatory agencies to pursue the benefits realized in an innovative pollution prevention measure. The partnership became a *process* for exploring, testing and validating new pollution prevention measures.

Step One, A Common Agreement

The first step in this *process* was a common agreement between EPA, the Washington State Department of Ecology and the Shipyard to establish the objectives, protocol and administrative controls necessary to pursue the testing and validation of the Shipyard's PCB proposal. In June of 1995, a Memorandum of Agreement was signed between the EPA, Washington State and the Shipyard establishing a cooperative effort to pursue the PCB proposal. This agreement not only marked a beginning for the Shipyard's ELP but became the "blue print" for future proposals that could be pursued through other Federal and State environmental initiatives.

Step Two, Regulatory Approval

The second step involved the Research and Development Permit required to test and validate a part of the ELP proposal which examined the by-products of PCB containing materials which are incinerated. The unanticipated complexity of the Permit application, coupled with the review and approval cycle, delayed the Shipyard's start of testing until late fall of 1996. Because the year long Pilot Project concluded in the summer, that part of the initial ELP proposal will be pursued separately and the findings reported once all testing and validation is complete.

Step Three, Test and Validation

The third step was the laboratory testing and validation of the proposal. The Shipyard collected and tested 16 samples of foam rubber and 16 samples of paints from six difference submarines spanning a twenty year construction period. These samples represented two types of foam rubber and the four types of paints that have been identified as having been originally formulated with PCBs. These materials will not leach PCBs when subjected to EPA's *Toxic Characteristic Leaching Procedure*, Method 1311, and do not test positive for PCBs when subjected to the EPA *Verification of PCB Spill Clean Up by Sampling and Analysis,* Method 560. Each sample was extracted using the EPA method for chemical extraction of PCBs in solids, *Organochloride and Polychloride Biphenyls By Gas Chromatography,* Method 8080, and by the SFE method. The extracts from both methods were analyzed by Method 8080 and, surprisingly, showed nearly identical levels of PCBs.

Evaluation of the SFE method used indicates that the elevated extraction chamber temperature, 510^0 F, may have decomposed the samples and allowed extraction of the more thermally stable PCBs. Though the Pilot Project has concluded, the Shipyard, along with experts in the field of polymer and analytical chemistry, will continue to study the SFE method by evaluating cold extraction, under 145^0 F, of PCB containing reference materials against cold extraction of PCB polymer materials in an effort to advance the theory originally proposed. The results will be published for industry use.

Step Four, Amending Regulation

The final step in the *process* will require a cooperative effort among regulatory agencies to recognize the scientific approach towards validating innovative pollution prevention measures then work with industry to amend regulations which unintentionally prohibit prudent pollution prevention measures. As the Shipyard's effort in validating the original proposed theory will continue beyond the year long Pilot Project, this final step will have to wait completion of the study.

The *process* described above is an Environmental Management System which affords regulatory agencies and industry an opportunity to advance the principles of environmental excellence. As the Shipyard is still engaged in this *process*, the end result will have to wait, however, it's not too early to realize the true benefits the Shipyard has achieved for the costs expended in the ELP.

IV PROGRAM COSTS AND BENEFITS

A. Costs

The Shipyard has expended $40,000 during the ELP Pilot Project in collection and analysis of samples. Additionally, over 1400 man-hours of time was spent by the environmental and legal divisions in generating the Memorandum of Agreement, the Research and Development Permit, the Progress Reports and in attending to the daily administration of the Pilot Project.

B. Benefits

The Shipyard realized three very significant benefits through the ELP. One, as expected, was the improved working relationship with the regulatory community. The second is a spotlight on the progress the Shipyard has made in advancing the principles of environmental excellence and, third, is an Environmental Management System designed to explore, test and validate innovative pollution prevention measures.

The Shipyard can achieve enormous potential savings attributed to the SFE method for PCB analysis. Preliminary work with SFE suggests that this method may offer the Shipyard several significant pollution prevention opportunities. Because SFE uses carbon dioxide in place of petroleum based solvents, a conversion to this method could eliminate up to 7 tons of chlorinated solvents from the Shipyard's annual air emissions. This method also offers significant cost savings in terms of manpower, material and waste disposal. Appendix B presents the comparative savings between SFE and conventional chemical extraction methods.

V SUMMATION

The ELP Pilot Project afforded the Shipyard an opportunity to develop a *process* which represents an Environmental Management System designed to explore, test and validate innovative pollution prevention measures. This *process* relies on the common agreement between the regulatory community and industry to advance the principles of environmental excellence. The ELP was a first step away from the regulatory command and control philosophy of the past towards a more creative forum that can affect measurable improvement to the environment. Creativity often requires industry to "step out of the box." Thus, the challenge for all participants is to achieve complete consensus in the objectives and approach to initiatives such as the ELP. The benefits of these initiatives results in true savings that are realized in such fields as SFE methodology where Shipyard costs are reduced by over 80 percent and the environment is spared 7 tons of annual air emissions.

This Final Report concludes the ELP Pilot Project. However, as the year long effort ended without completely validating the proposal, the Shipyard will continue to pursue the theory that PCBs are inextricably bound within the polymer matrix of materials commonly encountered in the ship recycling effort. In addition, research will continue into the by-products of PCB containing materials which are incinerated in an effort to support alternative disposal methods. The research results may be used by both the regulatory community and industry in the final step of a *process* to amend regulations which unintentionally prohibit prudent pollution prevention measures. Questions about Puget Sound Naval Shipyard's ELP Pilot Project can be addressed to Mr. Robert Cipra or Mr. Gerald Sherrel at (360) 476-6009.

VI APPENDICES

A. ELP Plan of Action and Milestones

B. Cost Comparison Supercritical Fluid Vs Conventional Extraction of PCBs in Solids

Appendix A

ELP
Plan of Action and Milestones

Action	Status	Milestone Date
Issue Memorandum Of Agreement	Complete	July 95’
Identify And List The Organizations Required In The Process	Complete	July 95’
Establish A List Of Responsibilities For The Participating Parties	Complete	July 95’
Contract With Portsmouth Naval Shipyard To Perform Supercritical Fluid Extraction.	Complete	August 95’
All Party Conference To Discuss Responsibilities And Assign Actions.	Complete	August 95’
Provide Copies Of ELP Related Audits.	Complete	August 95’
Collect Samples, Ship To Portsmouth Naval Shipyard For Extraction.	Complete	September 95’
Perform Baseline Audit Of ELP Related Area	Complete	August 95’
Submit 3 Month Progress Report	Complete	October 95’
Contract For Dioxin/Furan Analysis Of PCB Incineration By-Products.	Complete	November 95’
Perform Super Critical Extraction On Paints And Foam Rubber Samples	Complete	October 95
Submit 6 Month Progress Report.	Complete	June 96’
Perform R & D Of By-Products From Plastic And Rubber Incineration.	Ongoing	Ongoing
Submit 9 Month Progress Report.	Complete	June 96’

Provide Final Report Summarizing The Pilot Project Results.	Complete	October 96’

Appendix B

Cost Comparison:
Supercritical Fluid Vs Conventional Extraction
of PCBs in Solids

Per 10 Sample Extraction Set	Supercritical Fluid Extraction	Conventional Extraction
Sample Preparation	0.3 man-hours	0.3 man hours
Solvent Reduction	NA	1.0
Sulfuric Acid Clean Up	NA	0.3
Florisil Clean Up	NA	0.7
Laboratory Clean up	0.3	0.6
Waste Disposal Labor	0.1	0.5
Total Man-hour/Sample	0.7	3.4
Man-hour Rate, $55.00/hr	Subtotal: $38.50	Subtotal: $187.00
Material Costs	$9.00	$100.00
Waste Disposal Costs	$4.00	$ 20.00
	Subtotal: $13.00	Subtotal: $120.00
Cost per Extraction Set	Total: $51.50	Total: $307.00
x 10,000 Samples/year	**$52, 015**	**$310,070**